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AUTHOR Baker, Robert, F.; And Others
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ABSTRACT

A set of procedures were developed for evaluating the State Capacity Building Programs; (SCBP), state projects for increasing facilities for the dissemination of information related to education. Six scales were developed, based on questionnaire items, to evaluate the following six facets of state information-dissemination systems: comprehensive resource bases; coordinated resource bases; comprehensive linkages; coordinated linkages; available linkages, products, and services; and institutionalization. Step one of the procedures was a content analysis of the resources used as indicants of position on the six scales. Step two was an assessment of the reliability, or homogeneity, of the scales. Step three was a process of finding the scale values of the indicants and the states, using Rasch model procedures. Data were applied to 29 states that joined the program in 3 successive years and 27 indicants. Indicants were classified in the following types: print-based materials; exemplary program practices; instructional materials; and human resource files. Stages of development were awareness, adoption, implementation, and institutionalization. (Author/CTM)

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NTS Research Corporation
2634 Chapel Hill Boulevard
Durham, North Carolina 27707
(919) 493-3451

An Application of Psychometric Procedures in the Non-Psychological Domain: Development of Dissemination System Scales Using Classical Test Theory and Rasch Scaling Techniques

Robert F. Baker, Jolinda K. Decad,
Doren L. Madey, A. Jackson Stenner

Robert F. Baker, Jolinda K. Decad,
Doren L. Madey, A. Jackson Stenner
NTS Research Corporation
2634 Chapel Hill Boulevard
Durham, North Carolina 27707

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Introduction

For the past two years, NTS Research Corporation has been conducting a study of the State Capacity Building Program (SCBP), which is funded by the National Institute of Education (Madey et al., 1979). The purpose of the SCBP is to give a state financial assistance in the development and enhancement of that state's dissemination system. Extensive instrumentation has been developed by NTS to assess what theorists and practitioners in the dissemination field have conceptualized as the facets that underlie a comprehensive dissemination system. However, we are convinced that to use only individual indicants from this instrumentation would be inappropriate. The indicants are reflections of the true attributes or facets that underlie dissemination systems, and it is the impact of the SCBP on these facets rather than the individual indicants which is our focus of interest.

In order to develop a measurement scale for each of the facets, we have utilized several statistical procedures that have been developed and used primarily in the measurement of psychological attributes. Specifically, we have utilized procedures based on classical test theory and latent trait test theory, procedures that were originally developed to assess a person's true intelligence or academic achievement based on his/her responses to a set of questions. It would appear that these procedures need not be restricted to the psychological domain, but instead are sufficiently generic to be applicable to any situation where measurement of a latent attribute must be based on a series of empirical observations.

This paper is divided into three sections: a conceptual framework, the development of the scales, and some examples of the interpretive power of the

scales. The discussion of the conceptual framework establishes the context in which the scales are to be utilized, the development of the scales outlines the procedures used to derive the scales, and in the examples, the usefulness of two of the scales in providing a fuller understanding of the attributes of a dissemination system is explored.

Conceptual Framework

The State Dissemination Grants Program is a major initiative within the mission of the National Institute of Education "to promote educational equity and improve the quality of educational practice." The Program can be seen as contributing to an emerging nationwide configuration of efforts for the improvement of educational practice. NIE expects that State Dissemination Grants Program (SDGP) will aid the development of a nationwide capability for educational improvement by assisting a group of significant actors, state education agencies (SEAs), to strengthen their ability to provide "comprehensive and generalized" dissemination services to their clientele.

Under the sponsorship of the NIE's Program on Dissemination and Improvement of Practice, NTS Research Corporation is conducting a study of the capacity building component of the State Dissemination Grants Program (NIE Contract No. 400-76-0166, October 1976). Two major questions guide the NTS study:

- Is dissemination capacity being built as a result of this Program? If so, how?
- Is the Program having an effect? If so, what is the nature of the effect?

In order to answer the two major questions, four study questions have been developed:

- How are project characteristics, SEA dissemination system implementation and outcomes influenced by SEA and state contextual characteristics?

- How does NIE management of the SCBP relate to operations at the project level?

- How does the capacity building project affect implementation of the SEA dissemination system?

- What does the SEA dissemination system deliver and how does the SEA dissemination system improve local school practices and enhance educational equity?

A conceptual framework was also developed to specify and organize those variables which must be studied in order to answer the study questions. Figure 1 presents the conceptual framework underlying this evaluation.

The framework incorporates five components; the study questions indicate relationships between the components. The five components of the framework are: (1) Contextual Characteristics; (2) NIE Program Characteristics; (3) State Capacity Building Project Characteristics; (4) Facets of an SEA Dissemination System; and (5) Outcomes: System Outputs and Impacts.

- Contextual Characteristics refers to variables which describe contextual characteristics of the particular state and SEA. State characteristics include such variables as state size and school enrollment, while SEA characteristics include such variables as attitudes in the SEA towards change and the selection method of the chief state school officer.

- NIE Program Characteristics refers to variables which may relate to capacity building project characteristics. Included are program goals, program emphases, grant award criteria, project funding policies, and project monitor roles.

- State Capacity Building Project Characteristics refers to variables which describe the resultant program intervention at the SEA level; that is, the project's setting and activities. Project setting includes such variables as the project's number of years in SCBP and funding level, while project activities include such variables as extent and quality of planning and needs sensing.

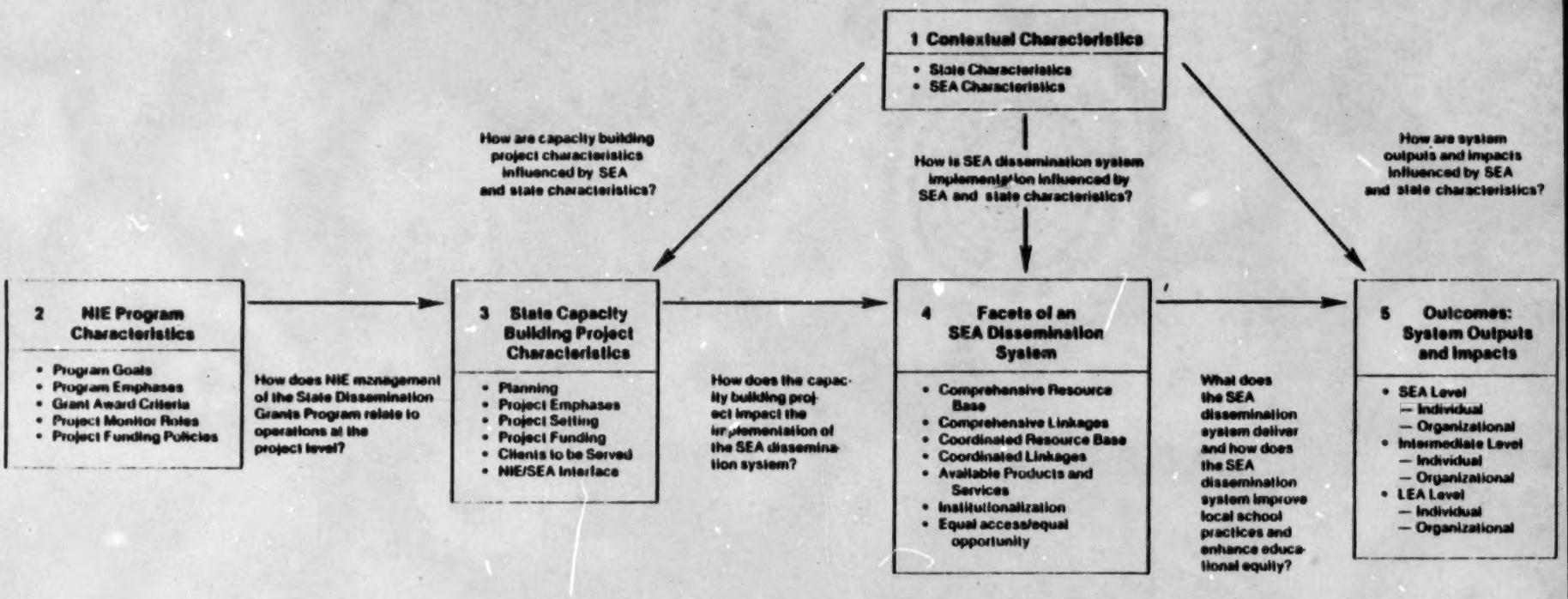

1 Contextual Characteristics
• State Characteristics
• SEA Characteristics
How are capacity building project characteristics influenced by SEA and state characteristics?
How is SEA dissemination system implementation influenced by SEA and state characteristics?
How are system outputs and impacts influenced by SEA and state characteristics?
2 NIE Program Characteristics
• Program Goals
• Program Emphases
• Grant Award Criteria
• Project Monitor Roles
• Project Funding Policies
How does NIE management of the State Dissemination Grants Program relate to operations at the project level?
3 State Capacity Building Project Characteristics
• Planning
• Project Emphases
• Project Setting
• Project Funding
• Clients to be Served
• NIE/SEA Interface
How does the capacity building project impact the implementation of the SEA dissemination system?
4 Facets of an SEA Dissemination System
• Comprehensive Resource Base
• Comprehensive Linkages
• Coordinated Resource Base
• Coordinated Linkages
• Available Products and Services
• Institutionalization
• Equal access/equal opportunity
What does the SEA dissemination system deliver and how does the SEA dissemination system improve local school practices and enhance educational equity?
5 Outcomes: System Outputs and Impacts
• SEA Level
— Individual
— Organizational
• Intermediate Level
— Individual
— Organizational
• LEA Level
— Individual
— Organizational

Figure 1 A Framework for the Evaluation of the State Capacity Building Program

- Facets of an SEA Dissemination System refers to variables that document the existence and organization of the resources, linkages, services, and institutional arrangements an SEA develops, implements, and institutionalizes to improve local educational practice and enhance educational equity. An SEA dissemination system, of which the capacity building project is usually just a portion, is depicted in both the theoretical literature and practitioners' assessments as being comprised of seven facets. Facet 1, Comprehensive Resource Base, refers to the types of resources (e.g., ERIC, promising practices files) that the SEA has the ability to access. Facet 2, Comprehensive Linkages, refers to the availability and use of a variety of individuals (e.g., SEA staff, IEA staff, LEA staff) and media (e.g., radio, television, publications) to connect educators with the information and services needed to improve local school practice. Facet 3, Coordinated Resource Base, refers to the extent to which various mechanisms for coordinating resources (e.g., formal referral process, knowledge by resource base personnel of other resources, use of other resource bases) are available and are used. Facet 4, Coordinated Linkages, refers to the extent to which the various linkages an SEA has available and uses are coordinated in order to provide all necessary resources to improve local school practice. Facet 5, Available Linkages, Products, and Services, refers to the resources that an SEA is able to provide; included are such variables as the specific contents of information packages (e.g., abstracts, citations, microfiche) and types of linker services (e.g., resource finder, process helper, solution giver) available. Facet 6, Institutionalization, refers to the extent to which the SEA dissemination system remains after NIE funding of the SEA's capacity building project terminates; the increased use of state funds for dissemination and statements by the chief state school officer supporting dissemination are examples of variables included in Institutionalization. Facet 7, Equal Access/ Equal Opportunity, refers to the extent to which the SEA dissemination system provides resources to all educators on all topics; variables include special materials on the handicapped, minorities, and women, and the targeting of dissemination efforts to individuals who work with these categories of students.

- Outcomes: System Outputs and Impacts refers to outputs of the SEA's dissemination system and their effects on the improvement of local practice and enhancement of educational equity. Outputs and effects of an SEA's dissemination system can be examined at three levels of the education system--the SEA itself, IEAs where present, and LEAs. In addition, both individuals and organizations can be examined at each level.

While the other framework components were measured by discrete variables or clusters of variables, for the fourth component, scales were constructed to describe state dissemination capacity in as concise and meaningful way as possible. Six scales were developed:

- Comprehensive Resource Base
- Coordinated Resource Base
- Comprehensive Linkages
- Coordinated Linkages
- Available Linkages, Products, and Services
- Institutionalization

The items that comprise the six scales were derived from the Project Director Questionnaire (PDQ), an instrument to collect project director assessments of contextual characteristics, project characteristics, and system characteristics; and the Capacity Building Indicants (CBI), a survey instrument that collects project director assessments about the status of the SEA Dissemination System with respect to the six facets. It was not possible to develop a useful scale for the equal access/equal opportunity facet because of a high degree of homogeneity of responses from all projects relative to that facet (e.g., all the projects responded affirmatively to all the indicants identified). The scaling procedures used in this study require substantial heterogeneity for a meaningful scale to emerge.

The procedures used to scale each facet of the SEA Dissemination System and to assign scale scores for each indicant on the scale and for each state involved a three step process. In the first step, indicants were selected and grouped into scales on the basis of their content. In the second step,

the empirical inter-indicant relationships were used to "prune" each scale of those indicants that did not seem to be measuring the same facet as the other indicants in the scale. In the third and final step, scale values were generated for indicants and states.

The scales served the following purposes:

- Confirmed that indicants grouped together on the basis of their content were, in fact, measuring the same thing.
- Discriminated among states in their development.
- Parsimoniously summarized a large body of data.
- Served as a measuring device by assigning facet scores to each state for use in further analyses.
- Eliminated indicants that were not related to the other indicants in a facet.

For each facet, the scale comprised a set of indicants that all measured that facet and also measured only that facet. As a consequence, the indicants were ordered on the scale and thus could reflect the degree to which a facet had been implemented by a state. For example, the scale measuring the comprehensiveness of the resource base had a number of resources arranged on the scale, with the ordering of the resources directly related to how many states possessed each of those resources. A state with high resource base comprehensiveness was assigned a scale score higher than the scale scores of resources that most states possess, but lower than the scale scores of resources that only very few states possess.

Step One: Content Analysis. In the first step, a content analysis of the available indicants was conducted to determine a set of indicants which appeared to roughly measure the same facet. The criteria for inclusion in this step were fairly liberal, in order not to eliminate an indicant that might, in fact, be

strongly related to other indicants, even when this was not immediately obvious from the indicant's content.

Step Two: Inter-Indicant Relational Analysis. In the second step, the inter-indicant correlations were used in a reliability analysis to assess the degree to which the indicants in each scale were all measuring the same facet. The coefficient alpha (KR_{20}) reliability was computed for the scale, along with statistics indicating the correlation between each indicant in the scale and the total of all of the other indicants, and the reliability of the scale if each indicant was excluded. The last two measures were both indications of the extent to which a particular indicant was measuring the same facet as the other indicants. Indicants which had low indicant-total correlations, or which lowered the average scale reliability were excluded. The remaining indicants were then reanalyzed using the reliability criteria just described. This was necessary because when the indicants had been eliminated, the statistics that related the remaining indicants to the total were altered from the statistics of the previous step. Consequently, an indicant that had not detracted from the scale's reliability in an earlier step might detract from the reliability in subsequent steps and thus need to be excluded. At the same time, the remaining indicants were reinspected with respect to their content. If any indicant presented interpretational problems even though it might be strongly correlated with other indicants in the set, it was eliminated.

Step Three: Scaling Analysis. When the final indicant set was selected for each facet, the third step in the process was to scale the values of both the indicants and the states, and further determine how well an indicant or a state fit the model. For example, for the comprehensive resource scale, the process just described produced a set of indicants all of which appeared to be measuring resource base comprehensiveness and all of which had strong,

inter-indicant correlations. In order to place these indicants on a scale of comprehensiveness, and then place the states on this scale of comprehensiveness, a statistical model developed by Rasch (1960) was used. The Rasch model allowed us to examine all of the responses to all of the indicants, and place the indicants and the states on a scale so that the similarities between the observed responses and the predicted responses were as strong as possible. To do this, the proportion of responses (e.g., right/wrong; provide/don't provide) to each indicant was computed and then transformed to calculate the indicant scale value, using the formula:

$$D_i = \ln\left(\frac{1 - R_i}{R_i}\right) ,$$

where D_i = scale value for indicant i

R_i = response proportion for indicant i

Following this step, the proportion of responses for each state was computed and combined with the scale values of the indicants to produce each state's scale value, using the formula:

$$B'_s = B_s + \frac{N \cdot R_s - \Sigma P_i}{\Sigma P_i(1-P_i)} ,$$

where B'_s = scale value for state s

B_s = initial estimate of scale value for state s using the formula

$$\ln\left(\frac{R_s}{1 - R_s}\right)$$

R_s = response proportion for state s

N = number of indicants in the scale

P_i = probability of state s responding positively to indicant i using the formula

$$P_i = \frac{e^{(B_s - D_i)}}{1 + e^{(B_s - D_i)}}$$

These formulae represent the first step of iterative computer algorithm discussed by Wright and Stone (1979) to obtain maximum likelihood estimates for person abilities and item difficulties. It has been the experience of many users of Rasch scaling techniques, however, that the initial approximations are often quite close to the final estimates (Ryan, personal communication), and obviously represent only a small computational burden.

To facilitate interpretation, all the scale values were adjusted so that the lowest indicant on the scale had a value of zero, and the highest indicant had a value of 100. If a state responded positively to all the indicants, the constraints of the model prohibited the placement of the state on the scale. For purposes of later analyses, the state was assigned a value of 200. If a state responded positively to all but a few of the indicants, the model tended to assign a scale value greater than 100 but less than 200 to the state. Given the large number of positive responses, the model would attribute the few negative responses to measurement error, and assign the state a scale value greater than any of the indicants.

The degree to which the objects and indicants fit the scaling model was then assessed. For each of the states, the fit statistic was the proportion of the state's responses that the model correctly predicts were answered affirmatively or negatively. Similarly, the fit statistic for each indicant was the proportion of the indicant's responses that the model correctly predicts. While the fit statistics for the indicants all tended to be high, an assessment of how well the states fit the model was important since the indicants were chosen to have high correlations with one another. If a state did not have a good fit statistic, then it was an indication that the scale did not adequately measure that state's process of building capacity. For example, a project having a poor fit statistic on the comprehensive resource base scale suggested that the project

had resources that it would not normally be expected to have and/or did not have resources that it would normally be expected to have. This, in turn, might imply that the resource base development of that project was different from that of other projects.

In Figure 2, the construct map for the comprehensive resource base facet is shown. Like the construct maps for the other facets, it includes a scale that ranges from 0 to 200, with a floor and ceiling zone. The indicants are plotted to the right of the scale; almost all the items are located between the values of 0 and 100. Occasionally, an indicant falls in the floor zone, which indicates that all the states responded affirmatively to the indicant. The states (represented by state number[1] and cohort[2]) are plotted to the left of the scale. The majority of the states are located between the values of 0 and 100. A value between 100 and 200 indicates that the state responded affirmatively to nearly all the indicants; a score of 200 means that the state responded affirmatively to all the indicants. The map also includes:

- Fit statistics that measure how well a particular indicant fit the scale (indicant fit) and how well each state fit the scale (state fit);
- The scale reliability (coefficient alpha) which estimates the internal consistency of the scale; and
- The average indicant reliability, which is the mean inter-item correlation.

Each SEA participating in the SCBP was located on the six scales. The location on the scale allowed assessment of where each SEA was in terms of the

[1]Each state was assigned a code number by using a table of random numbers.

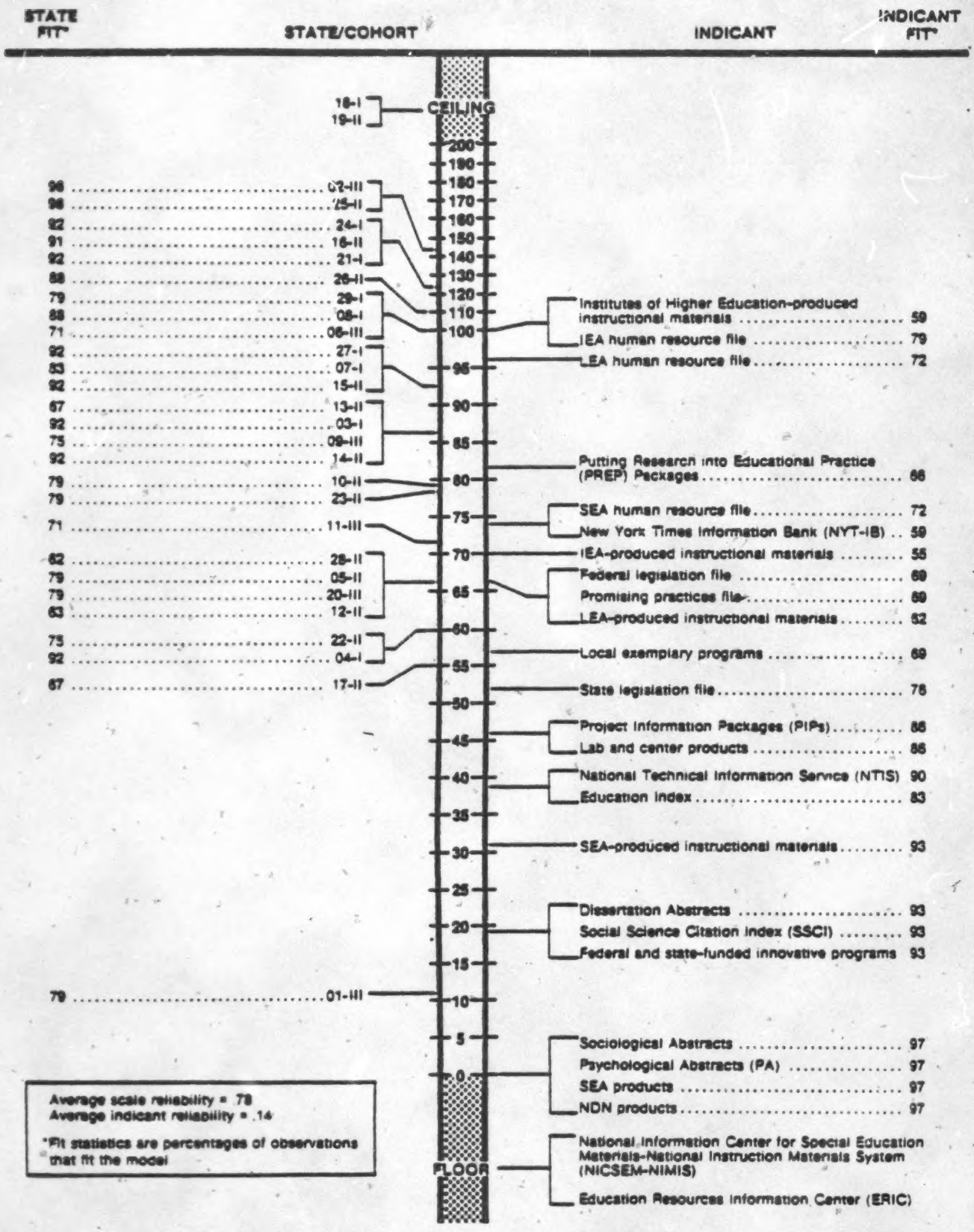
[2]Cohort represents which year each state joined the State Capacity Building Program.

Cohort I	1975
Cohort II	1976
Cohort III	1978

Figure 2

COMPREHENSIVE RESOURCE BASE

CONSTRUCT MAP



Average scale reliability = .78
Average indicant reliability = .14

*Fit statistics are percentages of observations that fit the model

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number of activities or products of that particular capacity building behavior. It must be emphasized that placement on the scale for any particular state did not represent a "better than" or "worse than" relationship with other states. Rather, the placement of the state represented a description of the kinds of materials or structures the state had developed as a part of its dissemination system. The placement of a state on the scale could be interpreted to indicate that most (but not necessarily all) of the activities described at its level and below were included in the state's dissemination system. The placement on the scale did not rule out the possibility that the state also had some of the elements described above its placement position. The placement was a "best" description of what each state dissemination system contained.

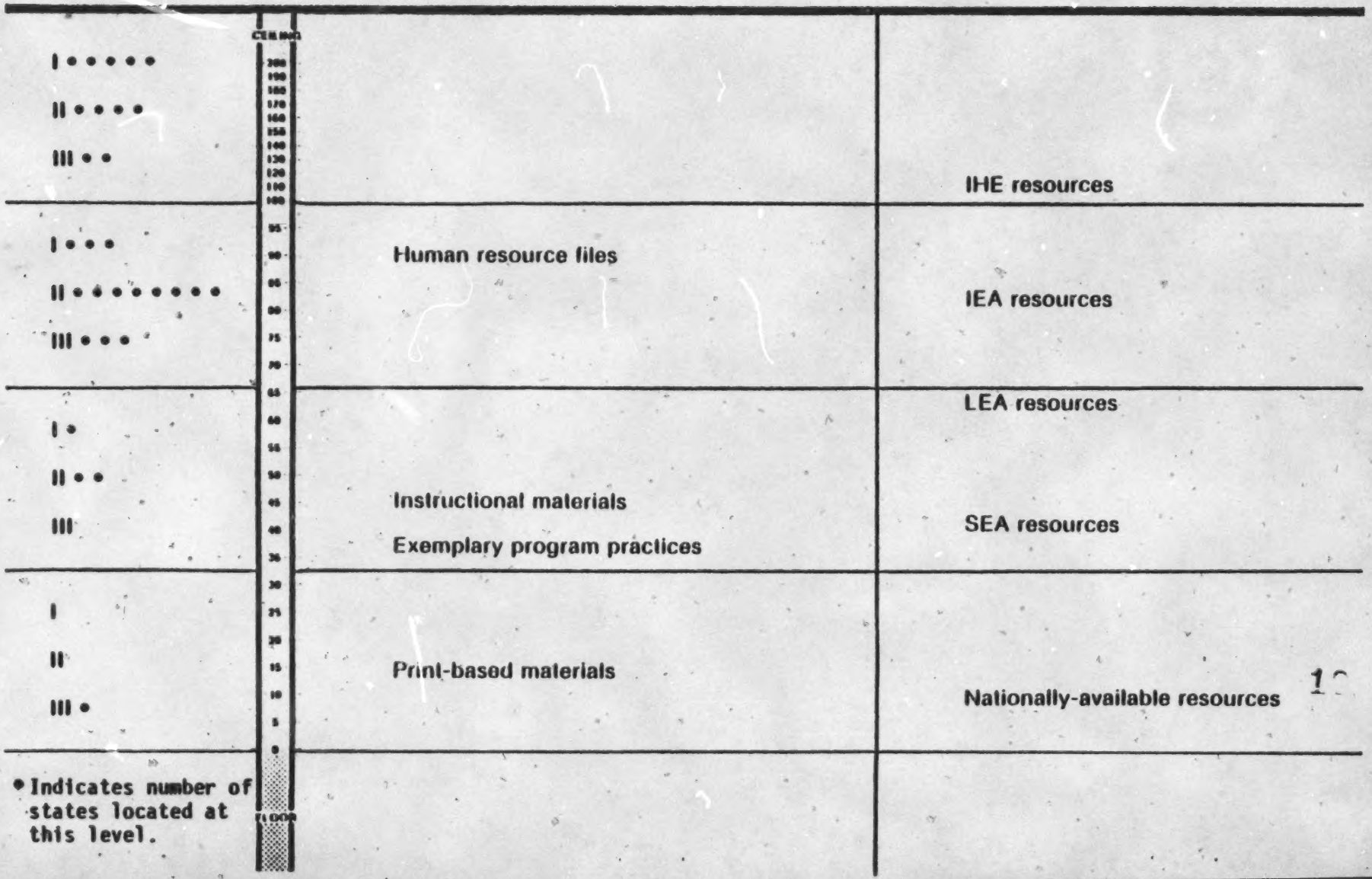
Examples of Scale Interpretation

In this section, two of the scales have been utilized to illustrate how interpretations can be drawn regarding the nature of the dissemination system facets. Figure 3 is an interpretive summary of Figure 2 and describes the pattern of state utilization of the components of a comprehensive resource base. In general, national resources are most often a part of the dissemination system, followed by SEA resources, LEA resources, Intermediate Education Agency (IEA) resources, and finally resources in institutions of higher education (IHEs).

Another apparent pattern in the scale involves the type of materials included in the comprehensive resource base: print-based materials are the most widely used resources; innovative programs, which include Federal and state-funded innovative programs, local exemplary programs, and ultimately a promising practices/programs file, and instructional materials are the next numerous; and

Figure 3

COMPREHENSIVE RESOURCE BASE



human resource files are typically the type of resource least often included in an SEA's comprehensive resource base.

All projects have access to two resources: Education Resource Information Center (ERIC) and National Information Center for Special Education Materials/ National Instruction Materials System (NICSEM/NIMIS). These resources are federally-supported and thus are relatively easy for states to access. Together ERIC and NICSEM/NIMIS materials provide a base upon which a comprehensive set of resources can be developed.

Other resource sources typically available are Psychological Abstracts, Sociological Abstracts, National Diffusion Network (NDN) products and SEA products, Social Science Citation Index, Dissertation Abstracts, and Federal and state-funded resources.

States in the middle range of the scale additionally have collections of exemplary program practices and instructional materials. These include: SEA-produced instructional materials, lab and center products, local exemplary programs, LEA-produced instructional materials, and sometimes such files as Education Index, National Technical Information Service and Project Information Packages (PIPs).

For states at the upper range of the scale, an SEA human resource file is included in the comprehensive resource base, as well as an LEA file and an IEA file. IEA-produced and IHE-produced instructional materials, the New York Times Information Bank and Putting Research into Education Practice (PREP) products are also included.

Low scores on the comprehensive resource base scale represent a state that includes ERIC and NICSEM/NIMIS and other nationally-available print-based materials in its resource base, as well as some SEA products. High scores on the comprehensive resource base scale represent the development of a comprehensive

resource base which contains both information files (documents, data, information on programs, practices, services) and human resource files.

The institutionalization scale is presented in Figure 4. This scale empirically assesses three hypothesized stages in the life of a capacity building project:

- Adoption, when the project becomes identifiable by the SEA;
- Implementation, when the project operationalizes its plan to build and refine the existing SEA dissemination system; and
- Institutionalization, when the project loses its "special project" status and becomes an integral part of the SEA dissemination system.

States at the lower range of the scale are in the adoption stage, and are developing efforts to create awareness of the project.[3] Interest in the project is stimulated by efforts to gain project support within the SEA and by efforts to increase demand for project services. An evaluation of project services follows: typically in the evaluation phase, project staff assist other programs in their preparation of dissemination plans and SEA personnel begin to gain an understanding of the project's functions. The trial phase is marked by the provision for gradual increase in state support for the project. Adoption typically occurs with the location of the project on the SEA organization chart.

States at the middle range of the scale are in the implementation stage, the operationalization and refinement of the adopted dissemination system. This phase is reflected in the planning for a comprehensive and coordinated dissemination system. As the activities on the scale indicate, the project involves others

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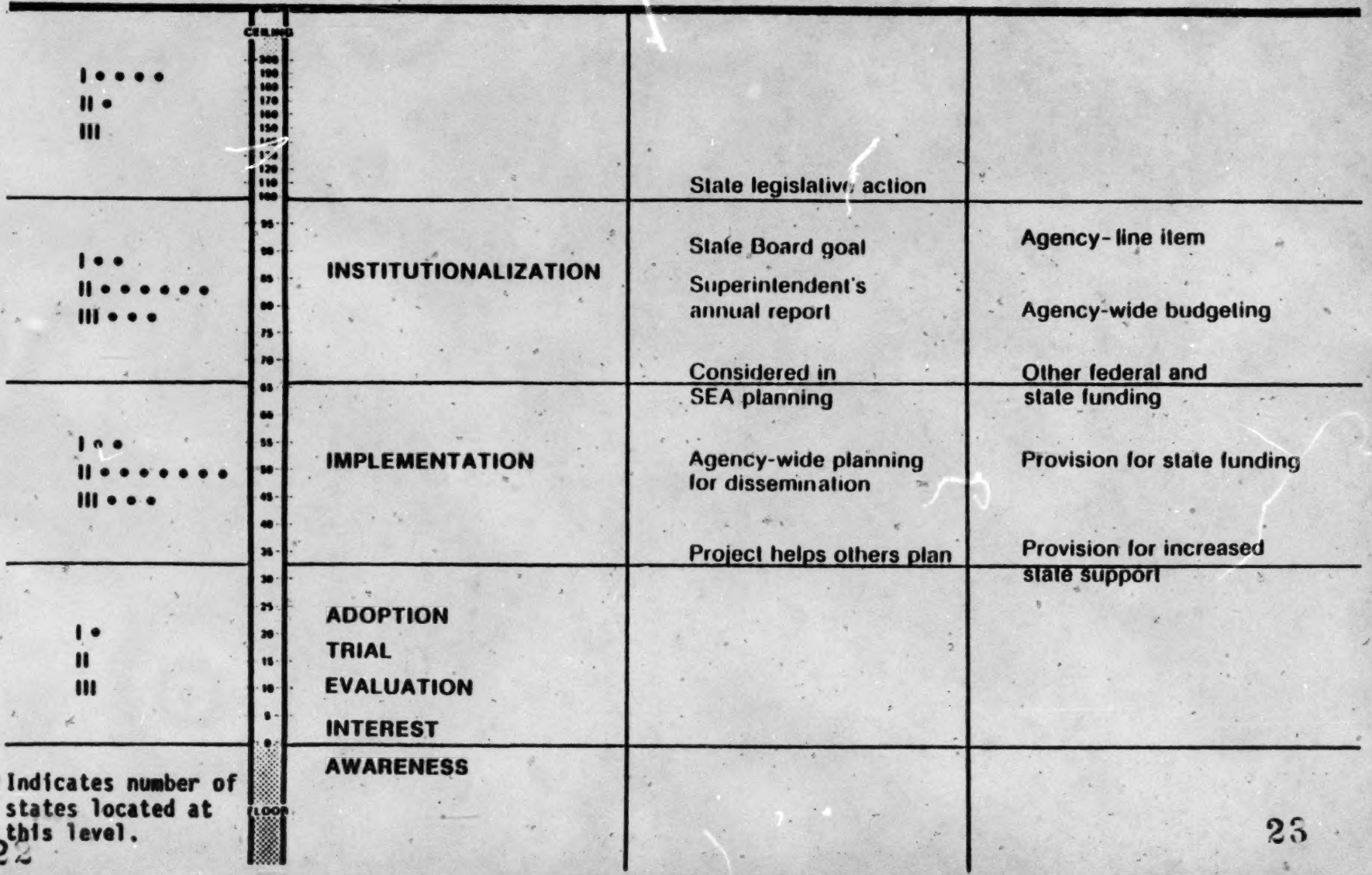
[3]This discussion follows the phases in the adoption process proposed by Rogers and Shoemaker (1972).

Figure 4

INSTITUTIONALIZATION



• Indicates number of states located at this level.

in its own planning process, continues with the project's representation in executive team sessions, and culminates in the consideration of dissemination in agencywide planning.

States at the upper range of the scale are in the institutionalization stage. Indicants of this stage are the provision for state funding of project activities after the grant ends, the contribution of other Federal and state funds to a coordinated dissemination function, agencywide budgeting for dissemination, and an agency line item specific to dissemination. The passage of state legislation dealing specifically with dissemination is the apex of the institutionalization scale.

States at the lower range of the scale are in one of the early adoption phases. A higher score on the scale represents a state in which the project has lost its "special project" status and become an integral part of the SEA dissemination system. Rather than speak of a "capacity building project," individuals in the SEA are likely to refer to a coordinated "dissemination function."

All of the scales were based upon data collected at one point in time, i.e., data are from a cross-sectional field collection effort. Because of this, we may speak of what projects and dissemination systems are like, not how they grow or develop over time. However, the data were collected from projects and SEAs at different points (years) in the State Capacity Building Program. As a consequence, one can consider the <u>possibility</u> that these projects are in different phases (stages) in developing their dissemination capacity. If this is a viable assumption, then one possible interpretation of the data presented through the scales is that they may suggest stages in, or a process of, development. Such an interpretation is relatively easy to apply to the scales, but such an interpretation is fraught also with serious problems. Consider, for

example, the comprehensive resource base scale. It is intuitively appealing to consider the development of the resource base as proceeding through the acquisition of nationally-available data bases (e.g., ERIC), moving through the stages of the collection of the materials which are more difficult to track down and obtain (e.g., LEA-produced instructional materials), to the development of materials which the project may have to develop on its own (e.g., a human resources file). Similarly, one can interpret the linkage system as going through a series of stages of increasing complexity--resource finder, solution giver, process helper. However, there are real problems in making such conclusions on the basis of these cross-sectional data. The development may not follow that pattern over time; the actual pattern of behavior should be examined across time periods. Projects and dissemination systems have different needs to fill based upon a variety of contextual factors within which they are located. In some cases the scales would seem to indicate that "more" is better. But "more" may not be better for all situations and therefore the patterns may be different or, indeed, reversals may even occur if there are patterns of development.

In short, we believe that the scales lend themselves to a developmental paradigm. Such a paradigm would be helpful to the policy maker and to the scientific and practice communities. But more examination and data collection need to be done. We intend to conduct such activities in the year ahead and to use the scales for the generation of hypotheses for further testing. Among the analyses that we expect to perform will be the placement of the data from both years on a single scale. This will enable us to assess the validity of the developmental paradigm in a truly longitudinal manner rather than just in a cross-sectional manner. In addition, should the relative positions of items in the scale shift from one year to the next, these shifts will be examined as possible consequences either of the developmental paradigm or shifting attitudes from one year to the next regarding how capacity should be built.

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NTS Research Corporation is a private corporation specializing in research and development, policy analysis, test scoring services, and market and survey analysis for Federal, state and local agencies as well as business and industry. Founded in 1973, NTS is a rapidly growing and vital company that reflects the research and development community in which it exists. Located in Durham, North Carolina, near Duke University, the University of North Carolina at Chapel Hill, North Carolina State University, and the Research Triangle Park, a nationally renowned research center, NTS complements its own highly skilled professional staff with the services of both local and national experts.

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Below is a brief listing of some recent and continuing NTS contracts:

- Educational Policy Development Center for Educational Quality and Improvement.
  Office of the Assistant Secretary for Education/Policy Development.
- Evaluation of the Fund for the Improvement of Post-Secondary Education.
  Department of Health, Education and Welfare.
- Evaluation of State Dissemination Grants Program for Capacity Building.
  National Institute of Education.
- Evaluation of Urban Area Experience-Based Career Education Program.
  Office of Career Education, US Office of Education.
- Follow-Up Study of Patients Who Had I-131 and Other Diagnostic Procedures During Childhood.
  DHEW/FDA Bureau of Radiological Health.
- National Evaluation of Headstart Educational Services.
  Administration for Children, Youth and Families.
- Operation of the ESEA Title I Technical Assistance Center, HEW Region III.
  Office of Evaluation and Dissemination, US Office of Education.
- Delaware Item Pool Development.
  Delaware State Department of Public Instruction.
- Evaluation of the Comprehensive Project in Adult Functional Literacy Education.
  North Carolina State Board of Community Colleges.
- ESEA Title I Evaluation: District of Columbia.
  District of Columbia Public Schools.
- Educational Policy Development Center for Educational Quality and Improvement.
  Office of the Assistant Secretary for Education/Policy Development.